



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.12.2003 Bulletin 2003/51

(51) Int Cl.7: **C03B 23/03**, C03B 23/023,
C03B 35/20, C03B 23/027,
C03B 23/025

(21) Application number: **03101622.3**

(22) Date of filing: **04.06.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(71) Applicant: **Tamglass Ltd Oy**
33730 Tampere (FI)

(72) Inventor: **Yli-Vakkuri, Erkki**
2074, Marin-Epagnier (CH)

(30) Priority: **12.06.2002 FI 20021131**

(74) Representative: **LEITZINGER OY**
Tammasaarekatu 1
00180 Helsinki (FI)

(54) **Apparatus for bending and tempering glass panels**

(57) The invention relates to an apparatus for bending and tempering glass panels. The apparatus comprises a number of ring moulds (1) for supporting and conveying glass panels; a number of preheating sections (2) for heating glass panels to a bending temperature; at least one prebending section (2a) for sagging a glass panel gravitationally; a bending section (3) pro-

vided with a hoistable and descendable press mould (4); and an annealing section (12) for tempering a bent glass panel. The bending section (3) is provided with a hoistable and descendable mould supporting frame (7) for supporting the mould (1) from below during a press-bending operation. The supporting frame (7) is mounted on a mobile cassette wagon (8) which constitutes a replaceable floor for the bending section (3).

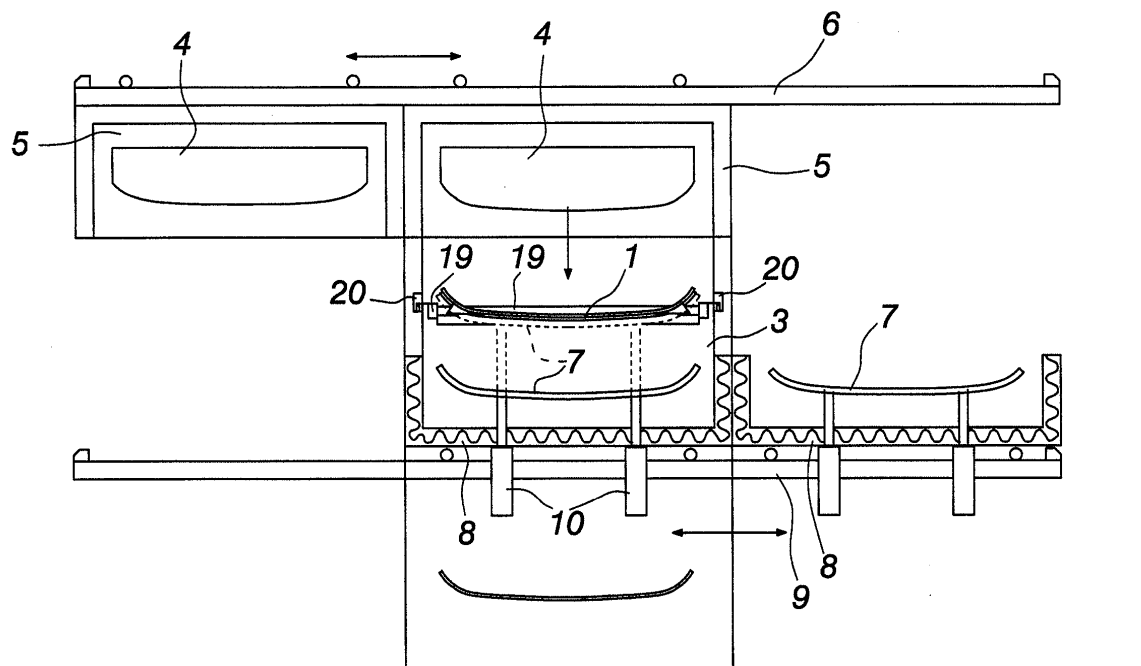


Fig.2

Description

[0001] The invention relates to an apparatus for bending and tempering glass panels, said apparatus comprising

- a number of ring moulds for supporting and conveying glass panels;
- a number of preheating sections for heating glass panels to a bending temperature;
- at least one prebending section for sagging a glass panel gravitationally;
- a bending section provided with a hoistable and descendable press mould; and
- an annealing section for tempering a bent glass panel.

[0002] Similar types of equipment without a press mould are known from patent publications US-5,306,324 and EP-624244. However, these devices do not possess a capability of bending complex forms presently appearing e.g. in the double-curvature rear windows of automobiles. On the other hand, e.g. the patent publication US-5,695,537 discloses a press-bending apparatus, wherein a glass element, having been bent gravitationally on a ring mould, is subjected to final bending by means of a press mould. In order to make a gable-hinged mould sufficiently rigid for a press-bending operation, the mould will become relatively massive and structurally heavy. The heating and recooling of such moulds requires more heating and cooling effect or reduces production capacity of the apparatus.

[0003] It is an object of the invention to provide the above type of a bending and tempering apparatus for complex forms, which enables the use of a light-structured mould fit for gravitational bending or a hinge mould and a light-structured frame-like mould carrier also during a press-bending operation.

[0004] According to the invention, this object is achieved in such a way that the bending section is provided with a hoistable and descendable mould supporting frame for supporting the mould from below during a press-bending operation.

[0005] Such a supporting frame is preferably included in a mobile cassette wagon, which constitutes a replaceable floor for the bending section.

[0006] One exemplary embodiment of the invention will now be described in more detail with reference to the accompanying drawings, in which

Fig. 1 shows an apparatus of the invention in a schematic vertical section, and

Fig. 2 shows a cross-section through the press-bending section of the apparatus of fig. 1.

[0007] An unloading and loading section 18 is used for removing of bent and tempered glass panels from a

ring mould 1 (fig. 2) and for placing a glass panel to be bent on the ring mould which is conveyed into an elevator section 17 for lifting the mould onto an upper conveyor track 20. Fig. 2 illustrates how the mould 1 and the carrier 19 are essentially flush with each other and flanges present along the sides of the carrier 19 extend into grooves present in the furnace walls onto rollers of the conveyor track 20. A number of successive mould carriers 19, along with moulds 1 and glass panels to be bent, are adapted to be intermittently conveyable towards a bending section 3, having its ceiling provided with a hoistable and descendable male mould 4. A lower track 21 of mould carriers includes respectively successive mould carriers 19, along with moulds 1 and tempered glass panels. The mould carriers 19 of the lower track 21 are also adapted to be intermittently conveyable in a direction opposite to the conveying direction of the mould carriers present on the upper track of mould carriers.

[0008] First in the passage of the upper track 20 are preheating sections 2, in which the heating is based on forced convection which takes up its thermal energy from glass panels presently cooling by means of forced convection in lower cooling sections 15. Thus, the cooling of glass panels can be sped up in the cooling sections 15 and the heating of glass panels to be heated can be sped up in the heating sections 2. At the same time, this enables a more effective exploitation of thermal energy present in glass panels to be cooled. The sections 2 and 15 can be structurally and functionally essentially as described in the Applicant's patent publication US-4,986,842.

[0009] From the sections 2, the carriers 19, along with moulds 1 thereon, proceed into preheating sections 2a for effecting the principal heating of glass panels by radiation heating. Therefore, the sections 2a have their ceilings provided with electrically heated radiation heating resistances 22.

[0010] Next are prebending sections 2b, in which the temperature of a glass panel rises to such a degree that the glass panel begins to sag upon the ring mould 1 supporting the same. The number of prebending sections 2b is sufficient for reaching almost a final bending shape by gravitational bending in the final prebending section 2b. Thus, the male mould 4 present in the section 3 is only used for finishing the bending action to maintain a high optical quality. Resistances 23 present on the ceiling of the prebending sections 2b are also divided in a lengthwise direction of the furnace (in the conveying direction) for resistance sub-fields for providing a heat application pattern consistent with a desired bending form.

[0011] The sections 2a and 2b have a thermally insulated bottom 24, which constitutes a floor between the upper track sections 2a, 2b and lower track sections 14. On top of this floor 24 lie radiation heating elements 25 set below the level of the carriers 19 and the mould 1 and heating the bottom of a glass panel presently within

the sections 2a and 2b with direct radiation heat.

[0012] Since the carrier 19 is nothing more than a light-structured ring, and since the mould 1 is also a light-structured ring mould which is supported with its outward protruding brackets upon inward protruding brackets of the carrier 19, the mould 1 and the carrier 19 do not constitute a sufficiently robust assembly for press-bending performed by the mould 4. This problem is solved in the invention in such a way that the bending section 3 is provided with a hoistable and descendable mould supporting frame 7 capable of supporting the mould 1 from below during a press-bending operation. The supporting frame 7 comprises a circular ring complementary to the shape of the ring mould's 1 bottom surface. If necessary, the supporting frame 7 can be provided with positioning means for finalizing and precisizing the mould's 1 position within the bending section 3. If the ring mould comprises a so-called hinge mould provided with hinges at its ends, the supporting frame 7 has a shape which is complementary to the hinge mould's ultimate bending shape. The supporting engagement between the supporting frame 7 and the ring mould 1 need not be continuous as long as there are a sufficient number of supporting points around the ring.

[0013] The supporting frame 7 is carried by a mobile cassette wagon 8 which constitutes a replaceable floor for the bending section 3. Thus, when switching a bending shape, it is possible to provide the bending section 3 with a supporting frame 7 matching the contour of a mould. The supporting frame 7 is propped on the cassette wagon 8 by means of hoisting cylinders 10. Two adjacent cassette wagons 8 are mounted on a rail 9, which lies transversely to the conveying direction of the moulds 1 and which extends beyond the bending section 3 on either side, either one of the cassette wagons 8 being movable to establish the floor for the bending section 3.

[0014] The bending section 3 has a replaceable ceiling 5 which accommodates the press mould 4. Two adjacent ceilings 5, along with their press moulds 4, are mounted on a rail 6, which lies transversely to the conveying direction of the moulds 1 and which extends beyond the bending section 3 on either side, either one of the ceilings 5, along with their press moulds 4, being movable to establish the ceiling for the bending section 3.

[0015] The bending operation is followed by conveying a bent glass panel on the mould 1 and the mould carrier 19 through a rapid heating section 11 into an annealing section 12, which includes top and bottom cooling air boxes provided with nozzles for blasting jets of annealing air to both surfaces of the glass panel. The tempered glass panel is transferred in a lift section 13 onto the lower track 21, along which it is carried in a single long rapid nonstop passage under the sections 11, 3, 2b and 2a into the previously described cooling sections 15. Upon arrival in the first cooling section 15, the glass panel temperature is e.g. 440°C, which ena-

bles the transfer of a considerable amount of heat between the sections 15 and 2 by means of forced convection. However, the recovery of heat for heating the upper track glass panels is not absolutely necessary, but, instead, the upper track sections 2 can all be provided with radiation heaters 22 and the last lower track sections 15 can be provided with forced-convection based cooling, the thermal energy obtained therefrom being useful e.g. for heating a building.

Claims

1. An apparatus for bending and tempering glass panels, said apparatus comprising

- a number of ring moulds (1) for supporting and conveying glass panels;
- a number of preheating sections (2) for heating glass panels to a bending temperature;
- at least one prebending section (2a) for sagging a glass panel gravitationally;
- a bending section (3) provided with a hoistable and descendable press mould (4); and
- an annealing section (12) for tempering a bent glass panel,

characterized in that the bending section (3) is provided with a hoistable and descendable mould supporting frame (7) for supporting the mould (1) from below during a press-bending operation.

2. An apparatus as set forth in claim 1, **characterized in that** the supporting frame (7) is mounted on a mobile cassette wagon (8) which constitutes a replaceable floor for the bending section (3).

3. An apparatus as set forth in claim 2, **characterized in that** the supporting frame (7) is propped on the cassette wagon (8) by means of hoisting cylinders (10).

4. An apparatus as set forth in claim 2 or 3, **characterized in that** two adjacent cassette wagons (8) are mounted on a rail (9), which lies transversely to the conveying direction of the moulds (1) and which extends beyond the bending section (3) on either side, either one of the cassette wagons (8) being movable to establish the floor for the bending section (3).

5. An apparatus as set forth in any of claims 1-4, **characterized in that** the bending section (3) has a replaceable ceiling (5) which accommodates the press mould (4), and that two adjacent ceilings (5), along with their press moulds (4), are mounted on a rail (6), which lies transversely to the conveying direction of the moulds (1) and which extends be-

yond the bending section (3) on either side, either one of the ceilings (5), along with their press moulds (4), being movable to establish the ceiling for the bending section (3).

5

6. An apparatus as set forth in any of claims 1-5, **characterized in that** the mould (1) comprises a hinge mould.

10

15

20

25

30

35

40

45

50

55

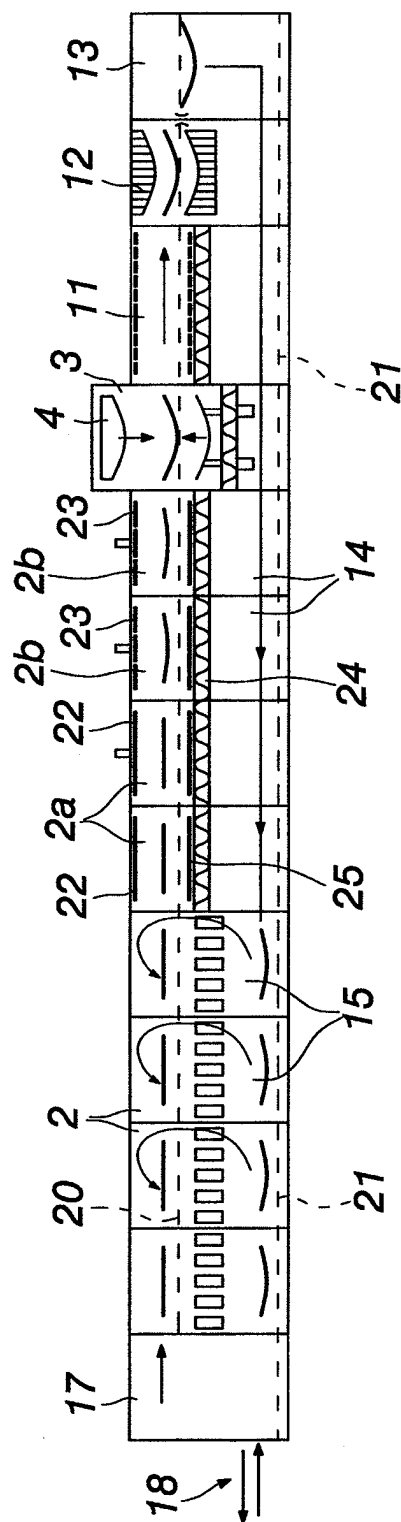


Fig. 1

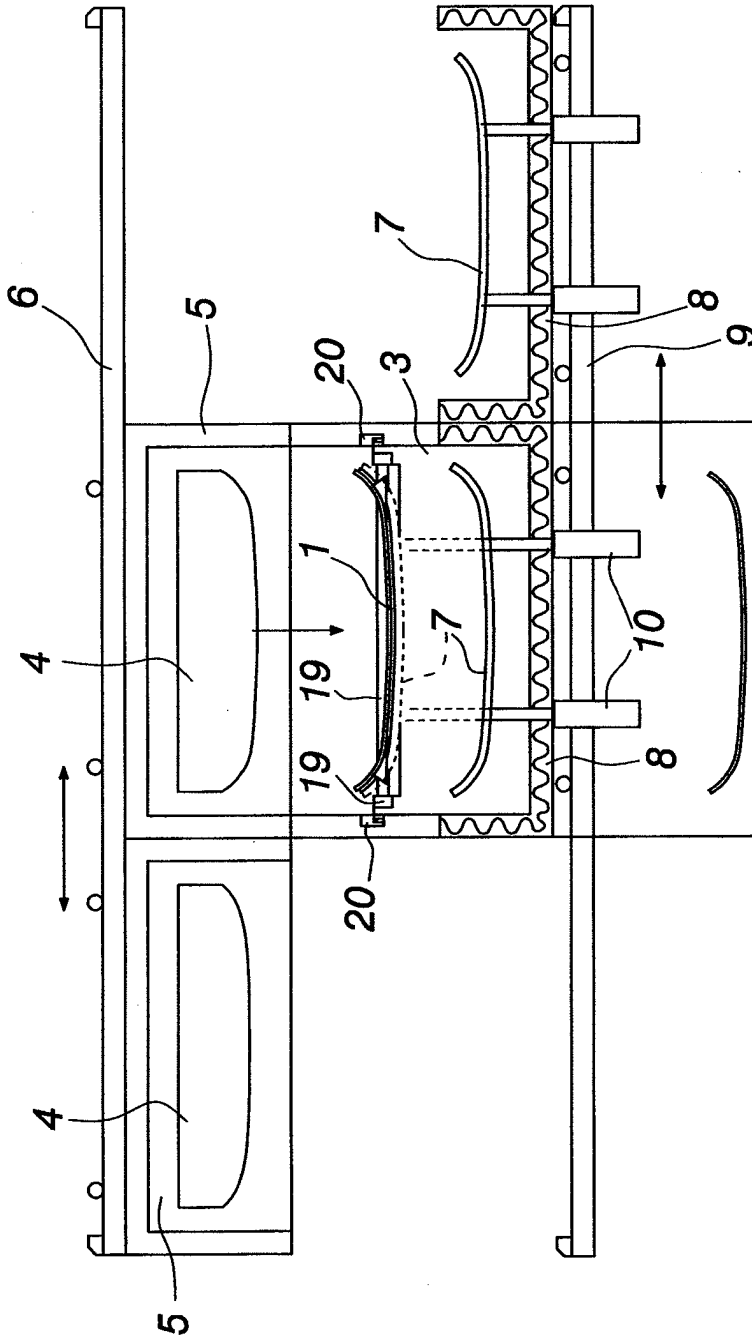


Fig. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 10 1622

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 338 216 A (ASAHI GLASS CO LTD) 25 October 1989 (1989-10-25) * column 7, line 19 - column 8, line 50; claims 1,8,13; figures 1-6 * * column 9, line 5 - column 11, line 24 * ---	1-3,6	C03B23/03 C03B23/023 C03B35/20 C03B23/027 C03B23/025
A	US 5 364 436 A (MONTONEN JORI) 15 November 1994 (1994-11-15) * the whole document * ---	1-6	
A	US 5 695 537 A (SYKES DAVID) 9 December 1997 (1997-12-09) * the whole document * ---	1-6	
A	EP 0 354 001 A (NIPPON SHEET GLASS CO LTD) 7 February 1990 (1990-02-07) * the whole document * ---	1-6	
A	EP 0 592 862 A (TAMGLASS ENG OY) 20 April 1994 (1994-04-20) * the whole document * -----	1-6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) C03B
Place of search MUNICH		Date of completion of the search 22 August 2003	Examiner Deckwerth, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 10 1622

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-08-2003

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 0338216	A	25-10-1989	JP	1230439 A	13-09-1989
			JP	7029792 B	05-04-1995
			JP	1827225 C	28-02-1994
			JP	2038332 A	07-02-1990
			JP	5030770 B	10-05-1993
			DE	68919429 D1	05-01-1995
			DE	68919429 T2	11-05-1995
			EP	0338216 A2	25-10-1989
			JP	1827230 C	28-02-1994
			JP	2051435 A	21-02-1990
			JP	5030771 B	10-05-1993
			US	4909820 A	20-03-1990
			US	5045101 A	03-09-1991
US 5364436	A	15-11-1994	FI	91522 B	31-03-1994
			AU	668593 B2	09-05-1996
			AU	4962593 A	12-04-1994
			CA	2144066 A1	31-03-1994
			DE	69322518 D1	21-01-1999
			DE	69322518 T2	06-05-1999
			EP	0660808 A1	05-07-1995
			WO	9406725 A1	31-03-1994
			JP	8501525 T	20-02-1996
US 5695537	A	09-12-1997	AU	5507696 A	30-12-1996
			WO	9640593 A1	19-12-1996
			BR	9609410 A	18-05-1999
			DE	69601266 D1	11-02-1999
			DE	69601266 T2	24-06-1999
			EP	0830320 A1	25-03-1998
EP 0354001	A	07-02-1990	JP	2175623 A	06-07-1990
			JP	2598475 B2	09-04-1997
			CA	1326365 C	25-01-1994
			DE	68905703 D1	06-05-1993
			DE	68905703 T2	08-07-1993
			EP	0354001 A1	07-02-1990
			KR	9703514 B1	18-03-1997
			US	5022908 A	11-06-1991
EP 0592862	A	20-04-1994	FI	91521 B	31-03-1994
			FI	932861 A	22-12-1994
			FI	933318 A ,B,	22-12-1994
			AT	149978 T	15-03-1997
			AU	666043 B2	25-01-1996
			AU	4879593 A	28-04-1994

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 10 1622

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-08-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0592862 A	CA	2107841 A1	16-04-1994
	CN	1088550 A ,B	29-06-1994
	DE	69308715 D1	17-04-1997
	DE	69308715 T2	19-06-1997
	EP	0592862 A1	20-04-1994
	JP	7300328 A	14-11-1995
	US	5437704 A	01-08-1995
	US	5472469 A	05-12-1995
	FI	935664 A ,B,	22-12-1994
